Small Business Innovation Research/Small Business Tech Transfer

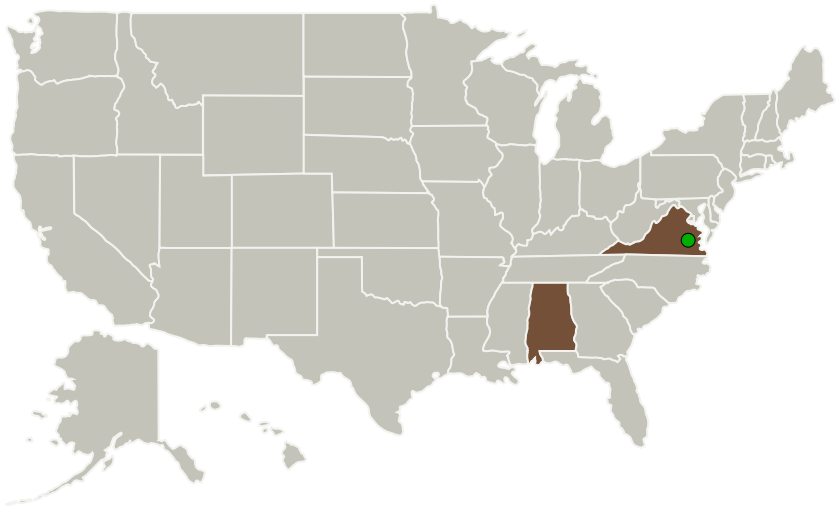
Unstructured, High-Order Scheme Module with Low Dissipation Flux Difference Splitting for Noise Prediction, Phase I

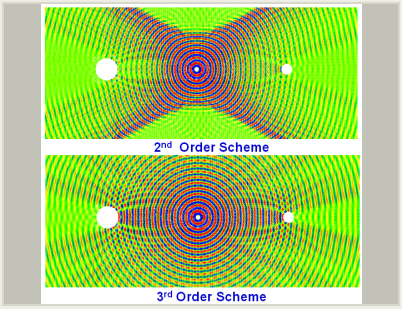
Completed Technology Project (2014 - 2014)

Project Introduction

Thorough understanding of aircraft airframe and engine noise mechanisms and the subsequent acoustic propagation to the farfield is necessary to develop and evaluate noise mitigation concepts. Therefore, continued assessment and development of advanced prediction methodologies and tools is essential. Despite significant progress made in computational fluid dynamics (CFD) in past several decades, some production unstructured CFD codes used at NASA for noise prediction are only 2nd order accurate at best. In this SBIR study, we propose to develop a modular high-order scheme with low dissipation flux difference splitting that can be integrated into existing CFD codes for use in improving the solution accuracy and to enable better prediction of complex physics and noise mechanisms and propagation. The salient features of our proposed approach include: (1) high-resolution schemes with physics-based low-dissipation flux-difference splitting; (2) very low memory requirements; and (3) modular structure for easy integration into existing CFD codes. During Phase I, a module providing 3rd order accurate schemes will be developed and integrated into FUN3D code. Verification and validation studies will be conducted to demonstrate the improved solution accuracy. During Phase II, 4th order accurate schemes will be developed and implemented with FUN3D, and the performance of improved schemes will be assessed for realistic aeroacoustic problems. Adaptive use of high-order schemes near solution discontinuities (such as shocks) will be investigated. Phase II plans will also consider integration of the high-order module with other unstructured CFD codes such as USM3D and Loci/CHEM.

Primary U.S. Work Locations and Key Partners





Unstructured, High-Order Scheme Module with Low Dissipation Flux Difference Splitting for Noise Prediction Project Image

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Unstructured, High-Order Scheme Module with Low Dissipation Flux Difference Splitting for Noise Prediction, Phase I

Completed Technology Project (2014 - 2014)

Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Alabama	Virginia

Project Transitions

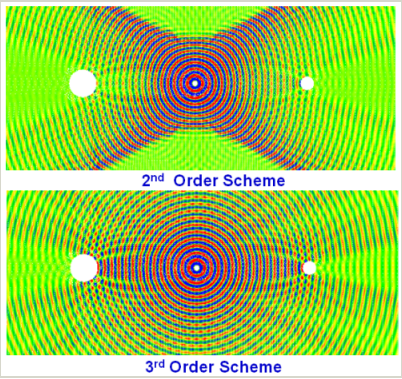
June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137543)*

Images



Project Image
Unstructured, High-Order Scheme Module with Low Dissipation Flux Difference Splitting for Noise Prediction Project Image *(https://techport.nasa.gov/image/127311)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
CFD Research Corporation

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

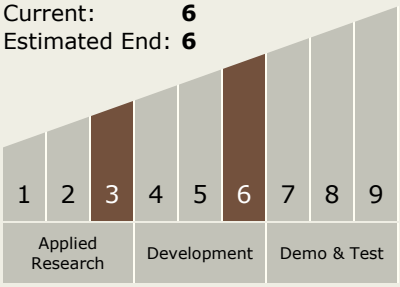
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
H Q Yang

Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



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Completed Technology Project (2014 - 2014)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.4 Aeroacoustics

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System